

Wafer Inspection for Monitoring Particles Added to Reticles During Exposure.

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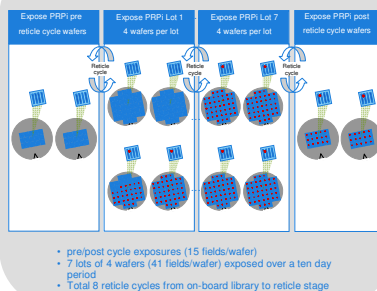
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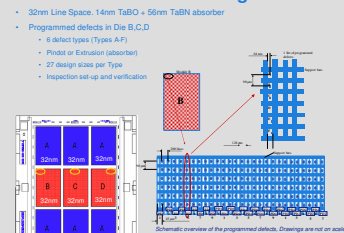
Abstract

Due to the absence of a pellicle for EUV lithography in manufacturing process a major concern is the impact on device yield due to contamination at reticle level. These particles added to the reticle device area have the potential to print on each device and severely impact yield. This paper describes a 'hotscan' method to detect these added reticle particles using wafer inspection. This 'hotscan' method can be used for NXE system qualification of particles added to the reticle and performance monitoring. The analysis of the 'hotscan' is able to deal with LWR effects. In addition, particle composition analysis via SEM/EDX on a dedicated monitoring reticle can be done without needing to take the device reticle off line for inspection. For this experiment a 32nm 1:1 vertical line-space reticle was used for the wafer exposures (ASML NXE:3100) at SK Hynix, and wafer inspection (KLA-Tencor 2835) and Defect Review SEM (KLA-Tencor eDR-7000) were executed at KLA-Tencor (Milpitas USA). Analysis of the wafer data was done to determine particles added to the reticle. This poster gives an overview of the experiment and analysis technique, results from particle composition analysis (SEM/EDX) and also correlate the findings to system events showing the benefit for this test methodology.

Method

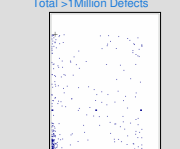
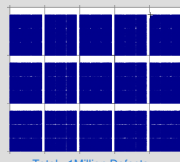


Multi-Die NXE reticle design



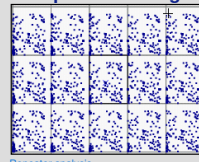
Analysis

Hot scan



Random repeaters identified

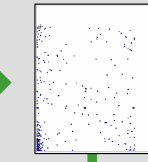
Repeater filtering



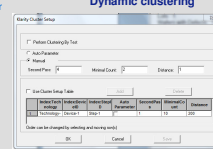
Repeater analysis
• Low tolerance algorithm for repeater detection
• Low tolerance for repeater capture & nuisance filter

Apply count Dynamic cluster once filtering

Reticle master list

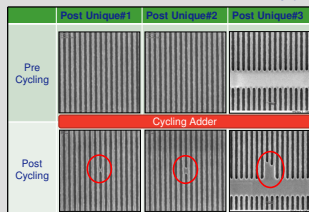


Dynamic clustering

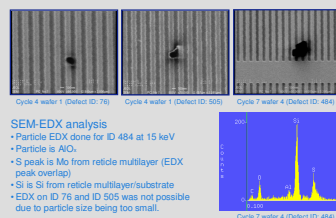


Results

- 3 Reticle Cycling adders are confirmed
- SEM review on both wafers to confirm added defects during cycling

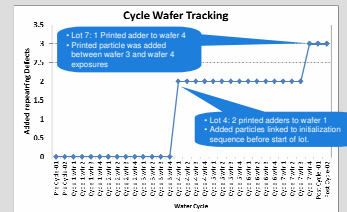


PRPI - Imaged Adder (SEM/EDX Analysis)



Defect Trace

Using Klarify Defect software the added repeating defects can be traced



Test has ability to :

- separate handling defects from printed adder defects during scanner operation.
- to narrow the time window in which a particle has been added to the reticle.
- show that no printed adder defects were deposited during exposure of wafers.

Future work:

- Verify methodology on smaller nodes (2Xnm).
- Investigate impact different illumination modes on printing and detection.

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Reference:

Comparison between existing inspection techniques for EUV mask defects (EUVL2010)

Dieter van den Heuvel, Rik Jonckheere, Eric Hendriks, Shaunee Cheng, Kurt Ronse, Tsukasa Abe, John Magana, Tristan Bret